Chapter 1

1. (a) 3

   (b) 4

   (c) 3

   (d) 1

   (e) 3

   (f) 2

   (g) 2, 3 or 4

2. (a) 5.6×10^4

   (b) 1.6×10^1

   (c) 6.6×10^{-4}

   (d) 2.1635×10^1

   (e) 2×10^{-1}

3. (a) 36,000

   (b) 100

   (c) 0.55

   (d) 31,600,000

   (e) 0.0000862

4. (0.15/4.26)100% = <u>3.5%</u>

5. $\% \text{ uncertainty} = \dfrac{0.01 \times 100}{5.65} = \underline{0.2\%}$

6. $A_1 = \pi r^2 = \pi(3.4 \times 10^4)^2 = 3.63 \times 10^9 \text{ cm}^2$
$A_2 = \pi\ [(3.4 + 0.1) \times 10^4 \text{ cm}]^2 = 3.85 \times 10^9 \text{ cm}^2$
$\Delta A = 3.85 \times 10^9 \text{ cm}^2 - 3.63 \times 10^9 \text{ cm}^2 = 0.22 \times 10^9 \text{ cm}^2$
$A = (3.6 \pm 0.2) \times 10^9 \text{ cm}^2$

7. $V_1 = \frac{4}{3}\pi r^3 = \frac{4}{3}(3.1415)(5.15 \text{ m})^3 = 572 \text{ m}^3$

$V_2 = \frac{4}{3}(3.1416)(5.15 \text{ m} + 0.08 \text{ m})^3 = 599 \text{ m}^3$

uncertainty = $|V_2 - V_1| = 27 \text{ m}^3$

$27 \text{ m}^3/572 \text{ m}^3 \times 100\% =$ <u>4.7%</u>

8. (a) 10^6 volts = 1 megavolt

(b) 10^{-6} meters = 1 micrometer

(c) 5×10^2 days = 5 hectodays

(d) 8×10^3 bucks = 8 kilobucks

(e) 3×10^{-9} pieces = 3 nanopieces

9. (a) 0.0356 m

(b) 0.000 025 V

(c) 0.000 250 kg

(d) 0.000 000 000 500 s

(e) 0.000 000 000 000 002 5 m

(f) 25 000 000 000 V

10. 50 hectokisses ≡ 5000 kisses
1 M buck in a year ≡ <u>1 millionaire</u>

11. <u>Question is subjective</u>

$70" \Rightarrow (70 \text{ inches})\left[\frac{1 \text{ m}}{39.37 \text{ inches}}\right] = 1.8 \text{ m}$

12. (a) (240 000 mi)(1000 m/0.621 mi) = $\underline{3.9 \times 10^8 \text{ m}}$

(b) $\underline{390 \text{ Mm}}$

13. $(1.0 \times 10^{-10} \text{ m})(1 \text{ in}/0.0254 \text{ m}) = \underline{3.9 \times 10^{-9} \text{ in}}$

14. 100 yd = 300 ft

$$100 \text{ m} \times \frac{3.28 \text{ ft}}{1 \text{ m}} = 328 \text{ ft}$$

Difference = 28 ft

$$\frac{28 \text{ ft}}{300 \text{ ft}} \times 100\% = \underline{9.3\%}$$

15. $1 \text{ yr} = 3.153\,600\,0 \times 10^7 \text{ s}$ (Prob. 21)
$2.998 \times 10^8 \text{ m/s}$ = speed of light

(a) $1ly = (2.998 \times 10^8 \text{ m/s})(3.153\,600\,0 \times 10^7 \text{ s})$
$1ly = \underline{9.45 \times 10^{15} \text{ m}}$

(b) $1 \text{ AU} = 1.50 \times 10^8 \text{ km}$
$1 \text{ AU} = 1.50 \times 10^{11} \text{ m}$

$$1ly = 9.954 \times 10^{15} \text{ m} \times \frac{1 \text{ AU}}{1.50 \times 10^{11} \text{ m}}$$

$1ly = \underline{6.30 \times 10^4 \text{ AU}}$

(c)
$$\text{speed of light} = 2.998 \times 10^8 \text{ m/s} \times \frac{1 \text{ AU}}{1.50 \times 10^{11} \text{ m}} \times \frac{60 \text{ s}}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}}$$
$$= \underline{7.19 \text{ AU/hr}}$$

16. Problem is subjective.
Estimate speed at 3 mi/hr
Row 8 hr/day, 5 days/week, 50 weeks/yr.
World is 25 000 miles around
speed = 3 mi/hr × 8 hr/day × 5 day/week × 50 week/yr = 6000 mi/yr

$$\frac{25000 \text{ mi}}{6000 \text{ mi / yr}} = 4.17 \text{ yr} \approx \underline{4 \text{ yr}}$$

17. Problem is subjective
Assuming 60 beats/min or 1 beat/sec
Average lifetime = 70 yr
$\simeq 70 \times 3 \times 10^7$ s
\# of beat = $\underline{2 \times 10^9 \text{ s}}$.

18. Problem is subjective

Picture body as a box 5'6" ft × 2 ft × 8 in

= 66 in × 24 in × 8 in

$= 12\ 672\ \text{in}^3 \approx 1.2 \times 10^4\ \text{in}^3 \times \left[\frac{2.54\ \text{cm}}{1\ \text{in}}\right]^3$

$= 2.08 \times 10^5\ \text{cm}^3$

$\simeq$ <u>$2 \times 10^5\ \text{cm}^3$</u>

19. (a) Problem is subjective

Estimate: 1 car/ 2 people

Each car needs service every 3 months

Each service lasts 2 hours

Each mechanic works 8 hours/day, 5 days/week, 50 wks/yr

700 000 people in SF

So: 350 000 cars in SF

Each mechanic works 8 × 5 × 50 = 2000 hours/yr

Each mechanic does 1000 repairs/yr

350 000 cars need 1 400 000 repairs/yr

So 1 400 000/1000 = <u>1400 mechanics</u>

(b) Left to reader

20. (a) Problem is subjective

Assuming non-stop driving:

Todays cars have speeds in this sort of race ~ 100 mph

Time in this case $\frac{10000}{100} = 100$ hr $\simeq$ <u>4 days</u>.

(b) Beijing to Paris ~ 10 000 miles. In 1906 average speed 20 mph.

$t = \frac{d}{\langle v \rangle} = \frac{10\ 000}{20} \sim 500\ \text{h} \sim$ <u>20 days</u>

21. (a) (1 yr)(365 days/yr)(24 hr/day)(60 min/hr)(60 s/min) = <u>3.1536×10^7 s</u>

(b) $(3.1536 \times 10^7\ \text{s})(1\ \text{ns}/10^{-9}\ \text{s})$ = <u>3.1536×10^{16} ns</u>

(c) $(1\ \text{s})(1\ \text{yr}/3.15 \times 10^7\ \text{s})$ = <u>3.17×10^{-8} yr</u>

22. $(1\ \text{g})(1\ \text{dealer}/250 \times 10^{-12}\ \text{g})$ = <u>4×10^9 dealers</u>

23. Measure AD and OD
From similar triangles

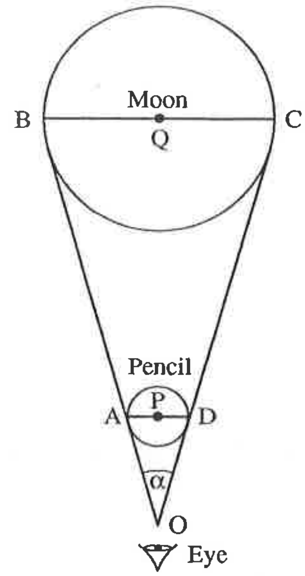
$$\frac{OP}{OQ} \simeq \frac{AD}{BC}$$

$$\Rightarrow BC \simeq \frac{(OQ)(AD)}{OP}$$

$$BC \simeq \frac{(3.8 \times 10^8 \text{ m})AD}{OP}$$

$AD \simeq 5$ mm and $OP \simeq 0.5$ m

$$BC \simeq \frac{(3.8 \times 10^8)(5 \times 10^{-3})}{5 \times 10^{-1}} = \underline{3.5 \times 10^6 \text{ m}}$$



24. Problem is subjective
Estimated 15 000 students, 2000 employees.
Assume 1500 employees drive, 3000 students drive
Average distance = 2 miles/trip × 2 trips/day = 4 miles/day
Cars get 20 mi/gal

$$\text{So } \frac{4 \text{ miles/day}}{20 \text{ mi/gal}} = 0.2 \text{ gal/day}$$

4500 drivers × 0.2 gal/day = 900 gal/day

25. Jar is about 8 marbles high 6 marbles in diameter so radius is 3 marbles
Volume = height × area = $8 \times \pi(3)^2 = 8 \times 28 = 226$
Round to 230 marbles.

Chapter 2

1. $\bar{v} = d/t$ = (220 km)/(2.25 h) = 97.8 km/h

2. $d = \bar{v}t$ = (31.0 km/h)(135 min)(1 hr/60 min) = 69.8 km

3. $t = d/\bar{v}$ = (22 km)/(30 km/h) = 0.73 h

4. $d = \bar{v}t$ = (100 km/h)(2 s)(1 h/3600 s) = 0.056 km = 56 m

5. (a) (55 mi/h)(1 km/0.621 mi) = 89 km/h

   (b) (88.6 km/h)(1000 m/km)(1 h/3600 s) = 25 m/s

   (c) (24.6 m/s)(1 ft/0.305 m) = 80.7 ft/s

6. (a) (1 km/h)(0.621 mi/1 km) = 0.621 mi/h

   (b) (1 m/s)(1 ft/0.305 m) = 3.28 ft/s

   (c) (1 mi/h)(1000 m/0.621 mi)(1 h/3600 s) = 0.447 m/s

   Another useful form is 1 km/h = 0.278 m/s.

7. (a) $\langle v \rangle = \frac{d}{t}$ = (8 × 0.25 mi)/(13.5 min) = 0.148 mi/min

   $\langle v \rangle$ = (0.148 mi/min)(60 min/h) = 8.9 mi/h

   (b) Average vel = 0 since displacement = 0